Согласно литературным данным примесь марганца имеет полосы возбуждения люминесценции при 275 нм (R-линия Mn^{4+}) [3] и 325 (Mn^{2+}-линия) [4]. На спектрах ФЛ керамических образцов Al_2O_3:Mn после возбуждения длиной волны 205 нм, показано наличие полос люминесценции с максимумами при 470 и 520, а при 325 – 670, 685 нм.

Установлено, что увеличение концентрации примеси приводит к снижению интенсивности полос (670-676) и (685-693) нм (R, R1, R2 линия), т.е. наблюдается концентрационное тушение люминесценции примесных центров. Показано что в образцах, синтезированных на воздухе эффект тушения наиболее заметен. Зафиксирован максимум интенсивности для полосы эмиссии 480 нм, соответствующей F^+-центру, при малой концентрации марганца 0,01-0,1 wt. %.

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1. K. Drdlíková, R. Klement, D. Drdlíka, T. Spusta, D. Galusekb, K. Maca. Journal of the European Ceramic Society, 37 (7), 2695–2703 (2017).
2. Dianguang Liu. Ceramics International, 39, 4765–4769 (2013).
3. I.V. Gasenkova, N.I. Mukhurov, S.P. Zhvavyi, E.E. Kolesnik, A .P. Stupak. Journal of Luminescence 185 (2017).
4. Anton I. Kostyuko, Aleksey V. Zhuzhgo, Vasily V. Kaichev, Alexander A. Rastorguev, Vladimir N. Snytnikov, aleriy N. Snytnikov. Optical Materials 75 (2018) 757-763.

LUMINESCENT THIN FILMS OF GADOLINIUM OXIDE DOPED WITH ERBIUM AND EUROPIUM IONS

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We studied the optical properties of thin film gadolinium oxide doped with erbium and europium ions. The experiment showed the existence of the UV-visible energy transfer from defective Gd^{3+} ions to activators, which can be widely used in multilayer energy conversion devices.

Thin film rare earth oxides are of great interest today for applications in multilayer devices operating with energy storage and conversion. Gadolinium oxide has a specific importance as matrix due to its high dielectric constant and refractive index, wide band gap and possibility to introduce various donor-acceptor pairs [1]. Our previous research have shown that intrinsic defects in nanostructured modification of Gd_2O_3 provide a new channel for UV-visible energy conversion [2, 3]. The main goal of this work is to determine how defects behave in thin films and what is the difference between the optical properties of a thin film and nanostructured Gd_2O_3.

The samples of thin films were synthesized in Institute of Physics and Technology, Ural Federal University. The films were deposited on quartz glass substrate (a high-purity optical glass of type IV). As activators for Gd_2O_3 matrix, the Er^{3+} and Eu^{3+} ions were chosen due to their bright green and red emission commonly used in optoelectronic devices. Optical absorption and photoluminescence spectra were recorded on PE Lambda 35 and PE LS 55 spectrophotometers.

Selective absorption band with maximum at 240 nm observed for Gd_2O_3 thin film (Fig. 1(a)) corresponds to the transition in Gd^{3+} ion. We found a similar feature for the case of Gd_2O_3 nanoparticles and established that such optically active lattice cations are defective and located near oxygen vacancies [2]. This means that the

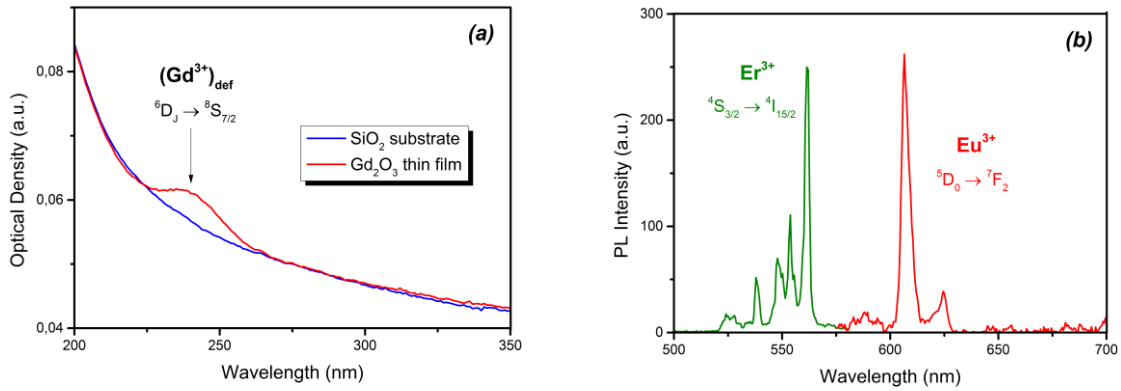

Fig. 1. (a) Optical absorption of Gd_2O_3 thin film on SiO_2 substrate; (b) Photoluminescence of Gd_2O_3:Er and Gd_2O_3:Eu thin films.

channel of UV-visible energy transfer from defective Gd^{3+} ions to activators can also be implemented in films, by analogy with nanoparticles. Photoluminescence spectra of films with Er^{3+} and Eu^{3+} activators confirm this assumption (Fig. 1(b)). Intense green and red luminescence of Er^{3+} and Eu^{3+} at excitation of Gd^{3+} ions (240 nm) indicates the energy transfer from defective cations of Gd_2O_3 to rare-earth acceptors. This effect can be used in multilayers energy conversion devices (for example, in tandem solar cells).

1. Liu G. K., Chen X. Y., Handbook of the Physics and Chemistry of Rare Earth (2007).
2. Zatsepin D. A. et al., Appl. Surf. Sci., 436, 697 (2018).
3. Zatsepin A. F., Appl. Mat. Today, 12, 34 (2018).